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ABSTRACT

To provide guidance for geography teachers, this booklet presents information on how to plan and execute aerial field trips. The aerial field trip can be employed as an effective visual aid technique in the teaching of geography, especially for presenting earth generalizations and interrelationships. The benefits of an aerial field trip are studying a region from a high vantage point for a total view, surveying an extensive area within a short period of time, and experiencing air topography and currents. Elements to consider when planning the aerial field trip include selecting the features to be viewed, determining the flight route, length of the field trip, selecting the type of aircraft to use, how many aircraft to use, altitude at which to fly, when to schedule the trip, cost of the aerial field trip, and preparation of flight map and log. The booklet offers short sections containing ideas about preflight classes and briefing and about postflight interrogation and review. Twenty-five photographs illustrating different aerial views of land conclude the booklet. (ND)

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GEOGRAPHY VIA AERIAL FIELD TRIPS

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NATIONAL COUNCIL FOR GEOGRAPHIC EDUCATION

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PLANNING THE AERIAL FIELD TRIP

When carefully planned and properly carried out the aerial field trip can be employed as an effective visual aid technique in the teaching of geography. More and more geography instructors are becoming aware of this fact and are contemplating such field trips, but are not quite sure how to proceed. To provide guidance to such teachers, the writers have prepared the following outline based upon their first-hand experiences over the past ten years.

Benefits of the Aerial Field Trip

Studied from the high vantage point of an airplane, any region provides interest and stimulation in the study of geographic phenomena. The aerial field trip can be particularly effective in such courses as physical geography, cultural geography, economic geography, geography of the state, or conservation of natural resources.

Field patterns and farmsteads, transportation and urban configurations, forests and croplands, landforms and waterways, along with evidences of soil erosion and conservation practices that may be indistinct, or even unnoticed, on the ground, become apparent from the air and thus more meaningful as entities in themselves, as well as in their local and regional settings. From the air, these phenomena force their attention upon students in a way which classroom lectures, discussions, and surface field trips fail to do. In addition, many more areas can be observed from the air than on the ground because of their remoteness or inaccessibility. The principal value of aerial field trips, however, lies in the fact that altitude decreases the scale of the surface of the earth, and, like a map, makes possible the immediate observation of large areas. Unlike the cartographer's map, aerial observations are nonselective; the multitudinous details of the physical and cultural landscapes are viewed as a continuous mosaic in all of their realistic interrelationships and spatial variations. From the air, the detail of the surface of the earth is seen as a part of the general mosaic background with the individual pieces fitted properly into the overall patterns. What occurs together on the surface of the earth is seen together from the high vantage platform of the airplane.

In addition, speed combined with altitude makes possible the survey of an extensive area within a short period of time. Surface field observations that would normally require many hours can be accomplished in much shorter periods by use of the airplane. Students can be scheduled for flights at hours during which they have no classes, thus eliminating a major problem of auto field trips which necessitates having students excused from other classes.

An indirect and auxiliary benefit of aerial field trips lies in the area of aerospace education. Many students, even of college age, have never flown. The aerial field trip serves the purpose of providing the student with flight experience. Not only is the student introduced to the new perspective of aerial observation and the new concept of speed by which distances can be traversed by the airplane, but he also experiences the "topography" of the air as the plane is affected by various air currents caused by the differential radiation of forests, highways, lakes, and plowed fields. These, if understood, are to be enjoyed by the students as they ride over the currents in the ocean of air.

The Reconnaissance Flight

The first phase in planning an effective aerial field trip should require the instructor to make a pre-view flight over the proposed field trip route. Preliminary reconnaissance may require criss-crossing the proposed field trip area several times in order to determine what physical and cultural features can be observed best from the air. A portable, transistor tape recorder may be used to advantage in making notes on this flight. The instructor will find that the reconnaissance flight affords the opportunity to make colored slides which can be used later in pre-flight instructional periods.

The aeronautics commission of the state may be contacted to provide assistance in arranging the planning flights.

Selecting the Features to be Viewed

The following is a check list of features which can be observed easily on aerial field trips.

I. PHYSICAL FEATURES

A. Surface and ground water features.

1. Stream patterns
2. Meanders (Figure 22)*
3. Slip-off slopes (Figure 22)
4. Undercut slopes (Figure 22)
5. Point bars (Figure 22)
6. Oxbows
7. Channel scars
8. Floodplains
9. Natural levees
10. Back swamps
11. Escarpments (Figure 11)
12. Braided streams
13. Deltas
14. Alluvial fans
15. Falls and rapids
16. Rills and gullies
17. Terraces
18. Sink holes
19. Uvalas
20. Erosional remnants
21. Bajadas
22. Bolsons
23. Hogbacks
24. Flatirons
25. Natural slopes
26. Pediments

B. Glacial features.

1. Moraines (Figure 14.)
2. Outwash plains
3. Till plains
4. Valley trains
5. Drumlins (Figure 12)

*All figures appear in numerical sequence beginning on page 12 through 20.

6. Kames
7. Kettles (Figure 9, No. 2)
8. Eskers (Figure 9, No. 1)
9. Crevasse fillings (Figure 15, No. 1)
10. Cols
11. Arêtes
12. Horns
13. Troughs
14. Erratics
15. Roches moutonnees
16. Hanging valleys

C. Wind features.

1. Yardangs
2. Blowouts
3. Dunes
4. Loess plains and canyons

D. Weathering and mass wasting features.

1. Talus slopes
2. Catsteps
3. Landslides
4. Evidences of solifluction
5. Mudflows

E. Shoreline features.

1. Tidal marshes and flats
2. Beaches
3. Bars
4. Headlands
5. Strand lines
6. Arches and stacks

F. Diastrophic and volcanic features.

1. Volcanic cones and necks
2. Sills and dikes
3. Fault scarps
4. Calderas

G. Vegetation.

1. Kinds of forests
2. Marshes and swamps (Figure 13 and Figure 15, No. 2)
3. Grasslands

H. Soils.

1. Soil patterns (Figure 16)
2. Soil erosion

II. CULTURAL FEATURES

A. Rural.

1. Farmsteads and ranches (Figure 16)
2. Field patterns (Figure 16)
3. Fences

4. Crops and pastures
5. Irrigation canals
6. Drainage ditches
7. Tile lines
8. Animals in fields
9. Field cultivation patterns
10. Farm machinery
11. Farm woodlots
12. Elevators
13. Orchards and truck gardens
14. Storage bins
15. Cemeteries
16. Camps
17. Sod farms
18. Cranberry bogs
19. Recreation facilities (Figure 20)
20. Forest preserves
21. Monasteries

B. Urban.

1. Central business district
2. Residential areas (old and new) (Figure 24)
3. Street patterns
4. Parks and pools
5. Cemeteries
6. Golf courses
7. Warehouses
8. Schools
9. Athletic fields
10. Sewage disposal plants (Figure 25, No. 1)
11. Public incinerators
12. Industrial areas
13. Shopping centers (Figure 17, No. 1)
14. Churches
15. Libraries, museums, and other special buildings (Figure 17, No. 3)
16. Shopping centers
17. Drive-in theaters

C. Transportation.

1. Railroads and marshaling yards
2. Roads and road patterns (Figures 18 and 25)
3. Trails
4. Slips and harbors
5. Docks and piers
6. Locks
7. Passenger and freight sheds
8. Airports (Figure 23)
9. Pipelines
10. Transmission lines
11. Bridges

D. Industrial and Manufacturing.
   1. Mills (Figure 19)
   2. Factories
   3. Power stations
   4. Dams (Figure 19)
   5. Mines (open pit, placer, and strip)
   6. Quarries (Figure 10)
   7. Pits (Figure 21)
   8. Proving grounds

E. Conservation.
   1. Game farms
   2. Farm ponds
   3. Terraces
   4. Field stripping
   5. Contour plowing (Figure 8)
   6. Diversion ditches
   7. Grass waterways
   8. Windbreaks
   9. Game preserves
   10. Strip cropping

F. Forestry.
   1. Logging camps
   2. Logging roads
   3. Fire lanes
   4. Fire towers
   5. Cut-over areas
   6. Christmas-tree plantings
   7. Nurseries

Determining the Flight Route

Following the instructor's reconnaissance flight, the identified physical and cultural features of particular interest which are to be included on the flight can be plotted on a large-scale base map. Once a pattern of features has been identified and plotted, the field trip route can be superimposed. The most desirable flight plan is one of few turns and long flight legs between turns. It is to be noted that the flight plan does not have to coincide with all of the features to be observed on the field trip as visibility is extremely good for several miles on each side of the route. In most cases it is advisable to plan the flight path to one side of the features to be observed so that they may be seen in a high oblique perspective. This makes observation possible for passengers seated on either side of the airplane, and makes it unnecessary for students to look down vertically which may prove disconcerting to the uninitiated.

Length of the Field Trip

The field trip should be of sufficient length to allow students time to overcome any apprehension they might have about flying, but short enough so that the trip is not tiring. A flight of about an hour's duration is probably most practical, although very effective aerial field trips of 30 minutes can be conducted. The distance of an hour's flight will be between 120-130 miles, while that of a 30-minute flight will be between 50-60 miles.

Selecting the Type of Aircraft

In planning an aerial field trip, the selection of the proper type of aircraft is important. A light, four-passenger airplane with the wing above is most practical because of its maximum downward visibility, greater maneuverability, stability, and slower speeds (Figure 1). With such aircraft, deviations occasionally may be made from the regular flight route in order to allow students to observe a particular feature from different angles. Altitude may also be varied in order that certain features may be seen better. Normally, phenomena may be observed easily from both sides of this type of aircraft, particularly if the pilot will raise or lower one wing. An additional advantage to using four-passenger planes is that they are usually available for charter purposes at airports in even smaller communities.

The one disadvantage in using small planes is that it is usually not possible for an instructor to accompany each flight. This, however, can be partially compensated for by properly briefing the pilots, as well as the students, in addition to supplying field trip maps and/or tape-recorded discussions of the field trip route. (See section on "Preparation of Flight Map and Log.")

How Many Aircraft to Use

Keeping in mind that the four-passenger aircraft will carry only three passengers in addition to the pilot, it normally will be desirable to charter several planes at one time, thus making it possible for a large group of students to participate in the field trip at the same hour (Figure 2). At Carroll College, where aerial field trips have been conducted in classes of Earth Science, Economic Geography, the Geography of Wisconsin, and Conservation of Natural Resources, over 2,500 students have been taken on such tours since 1958. As many as 100 students a day have been flown on aerial field trips. Beginning at 8:00 A.M., flights of four to six planes each continued throughout the day. Students with real, or imagined, motion-sickness problems were scheduled either early in the morning or late in the afternoon when there is least air turbulence.

Altitude at Which to Fly

The altitude flown may vary from leg to leg of the flight depending on what features are to be observed and what type of areas are traversed. On those legs of the flight where attention is directed to general land patterns and associations, the altitude should be higher than on legs where more surface detail is to be observed. The pilot, on the other hand, must maintain a high altitude over cities and large forested areas because of the safety factor. Shoreline features of large water bodies are seen best from the water side, and where these features are included on an aerial field trip, the distance flown from shore should be short and the altitude high to allow for a long glide path, if necessary. On the average, for best visibility of surface features, the altitude flown should be betwen 1,000-2,000 feet above the ground, depending upon the turbulence of the air (Figure 3). At altitudes higher than this the relief of the land is reduced to the point where all but the most rugged landform features become almost imperceptible.

When to Schedule the Trip

Weather conditions, in large measure, will determine the date on which the aerial field trip can be made. For maximum visibility and identification of surface features, a sunny day of low relative humidity is obviously desirable. In most cases it is necessary to schedule aerial field trips several weeks in advance, especially where large classes are involved; therefore, several dates should be tentatively set. If bad weather occurs on the first day, alternate days are thus available. Most airports and flying services are happy to cooperate in this manner. Aerial field trips should not be cancelled, however, just because the sun is not shining. Observations on cloudy days can be quite good, and such days generally afford smooth flying conditions.

Aerial field trips may be made during any season of the year, although each season has its own advantages, as well as disadvantages. The winter land surface is drab and largely colorless, and field patterns are minimized. Farmsteads, rural road patterns, and city blocks stand out sharply when there is snow cover. Some landform features are accentuated in the winter when the snow melts on some slopes. The winter surface has its peculiar characteristics, however, such as the erratic patterns on the snow in fields where farmers have spread manure (Figure 25), the tracks on slopes that are use for skiing and tobogganing, and the clusters of shanties on lakes where people are ice fishing.

The spring landscape has the advantage of soft variations in color and the absence of dense foliage on trees, which permits observation of features that are hidden during the summer. Soil patterns are most pronounced at this time of year, after the plowing has been done, but before the crops cover the land.

The summer land surface is the most verdant and varied, but also the one most completely covered by vegetation. Forested areas are dense and field crops so completely cover the ground that soil patterns are obscured. It is interesting to note, however, that in some cases soil patterns are reflected in different colors and heights of crops. Dwellings and streets in older residential areas are difficult to identify because of dense foliage. Field patterns and crops are particularly apparent at this season as this is the time of greatest agricultural activity.

Fall is one of the best seasons during which to observe from the air. Field patterns are distinct, and floodplains and marsh areas are accentuated by the varying colors of grasses. Autumn haze, however, may restrict visibility at times.

Regardless of the season of the year, the aerial field trip should be scheduled at the time when the student has gained a considerable amount of geographic information. The importance of this point lies in the nature of the perspective from which the student will be observing phenomena on the surface. In order for the aerial field trip to be something more than just another airplane ride, the student must possess a broad enough geographic background to be able to single out a multitude of features from their complex settings, and at the same time be able to observe and interpret spatial distributions and variations. To bring order out of the seemingly chaotic assemblage of landscape features requires more than cursory geographic background.

Cost of the Aerial Field Trip

The individual cost of aerial field trip flights will vary, of course, from area to area, but may be estimated at the rate of approximately $1.00 for each 10 minutes of actual flight time. Thus, an hour's flight would cost $6.00 per student. Students should pay this fee directly to the cashier at the airport on the day of the flight. By so doing, the aerial field trip becomes a matter of each student chartering a private plane, and the airport, or flying service, becomes fully responsible.

It is beyond the scope of this report to discuss the legal aspects of liability involved in aerial field trips. This is always a problem encountered by the teacher regardless of the type of field trip conducted. It would be wise for an instructor to consult a local lawyer concerning the liability of a teacher and school in case of injury. Most air services carry substantial insurance on each passenger. It should be pointed out that an aerial field trip presents no greater risks than do surface field trips.

Preparation of Flight Map and Log

If four-passenger airplanes are used for the field trip, it is not possible for an instructor to accompany each flight. A field trip map (Figure 4) and flight log, therefore, should be prepared from information gathered on the reconnaissance flight. The field-trip map should be of lap size so that the student may refer to it frequently during the flight (Figure 5).

Aeronautical sectional charts, county maps, state maps, or road maps may be used as the base map for drawing the field-trip map. The map must contain enough detail so that the student can constantly orient himself in the air, but not so much data that the map is difficult to read. Desirable features to include on the field-trip map are: lakes, streams, major roads, cities, political divisions, and the flight plan. The specific points of interest can be numbered consecutively along the well-defined flight route.

It is important that each student have a field-trip map, not only to take along on the flight, but to study before the flight. It is necessary, therefore, to duplicate the field-trip maps in quantity. If the base map which has been selected is small enough, duplication may be done by a number of inexpensive processes. More elaborate maps may be reproduced in sharper detail by offset printing. The cost of reproduction by the latter process is about 10¢ per map in large quantities.

The identification of surface features by and orientation of students in the air may be refined by supplying a tape-recorded discussion of the field trip. Long-playing, inexpensive tape recorders are available, and can add much to the field trip. First, the instructor must fly along the field trip route, noting the time when each feature appears at that particular speed on the airplane. The discussion can be re-recorded on the ground where additional information may be interjected and where engine noise does not interfere with the commentary. Care must be exercised to keep the discussion timed properly so that when the tape is played back to the students in the air the discussion corresponds to the appearance of the phenomena below the plane. Multiple ear-phone jacks can be installed on the tape recorder so each student, and the pilot, may have their own head-sets (Figures 6 and 7). The pilot can alter the speed of the plane to correspond to the instructor's tape-recorded discus-

sion. If tail or head winds make it impossible to satisfactorily adjust the speed of the plane to the tape-recorded discussion, the tape may be reversed or advanced to the proper place as needed.

It is desirable to prepare a field-trip brochure and flight log to accompany the field-trip map. The purpose of the brochure is to provide the student with background information of the area to be traversed, along with detailed information concerning specific features to be observed, and pre-flight directions and suggestions. This log and brochure should be distributed to students several days before the field trip in order that they might familiarize themselves with the route. Students should be encouraged to use the brochure on the field trip for occasional reference only.

PRE-FLIGHT CLASSES AND BRIEFING

On the day before the aerial field trip, the class discussion should be devoted to the area which will be traversed. The instructor can discuss features which will be seen on each leg of the flight. Colored slides, made on the reconnaissance flight, may be shown in order to give students the perspective from which they will be viewing geographic features the next day.

Students should be advised of certain conditions concerning the aerial field trip. If the day is sunny, they should take along a pair of dark glasses or a visored cap, as sunlight is very bright in the cabin of a small plane. Binoculars are of little value on a field trip of this type, but students should be permitted to take them along if they wish. An explanation by the instructor on how to follow the flight plan on the field-trip map while in the air provides a lesson in map reading.

It is recommended that students be encouraged to take their cameras on the aerial field trip. Excellent photographs can be made through the cabin windows with only an inexpensive camera. Care should be exercised to refrain from resting the camera or body against the side of the aircraft because the vibration of the plane may cause the photographs to be blurred. The aerial photographs will be more meaningful if a record is made in a notebook of the subject, direction, and altitude of each picture. The pilot can supply such information for the students. Much more detail may be observed from a careful study of the aerial photographs than from direct aerial observation alone.

It is necessary to instruct students to be at the airport at least 30 minutes before their scheduled flight time in order that a pre-flight briefing session can be conducted. This briefing session should be for the pilots, as well as for the students. The display of a large-scale map of the field trip route will serve as the focus of discussion about the flight and the features to be observed.

Weeks of planning, of reconnaissance flights, of drafting maps, and writing brochures have been a part of the preparation. You hope that you have done your job well in the classroom discussions and briefing sessions for your students are now heading for their planes with their pilots. Your aerial field trip has become a reality. And, as you watch the successive planes surge down the runway and into the air, you can have that confident feeling of having provided for your students a new frontier in geographic learning.

POST-FLIGHT INTERROGATION AND REVIEW

Post-flight interviews are illuminating in assessing the value of an aerial field trip as an instructional tool in geography and conservation. Said one student as he alighted from his flying classroom, "I never expected to see so many gullies!" Another student saw the aesthetic value of good land management when she exclaimed, "The farmers have made the land into a beautiful mosaic." Another observer commented that he traveled frequently through the area flown over, but admitted that he had never *really seen* the land until he viewed it from the air. Other students commented on the contrasts between older residential areas and new subdivisions, the regularity of the rural roads, the distribution of forests to correspond to slope lands, and the way parking lots stood out in urban areas. Some students expressed surprise at the sizes of lakes, quarries, marshes, and certain landform features, such as drumlins.

The Farm Management Agent in Waukesha County commented, "There is no better educational tool than the airplane to teach the cause, the effect, and the control of soil erosion, including water pollution and conservation practices." He further expressed his enthusiasm for aerial field trips when he said, "There is a different perspective from the air that allows one to grasp the whole situation. "From the air there is a variation in the color of the soil and crops. "When this is seen from the air, students and farmers alike are usually convinced as to what caused it."

Following an aerial field trip which the Geography Department at Carroll College conducted for area farmers, the Director of the Waukesha County Work Unit of the Soil Conservation Service remarked that he had received many requests for farm plans. He added that from a practical viewpoint he saw value in such aerial observations as a means of checking on the progress and maintenance of conservation programs.

The aerial field trip is a major experience in the lives of most students. As a result, it is recommended that a period following the aerial field trip be devoted to student discussions of their impressions. Many students will have questions concerning the interpretation of various cultivation patterns, what certain buildings are used for, and the identification of certain crops. Circular green fields in central Wisconsin, for example, proved to be potato fields that were being irrigated by a circulating sprinkler. Unusual shaped buildings in a field were found to be ginseng sheds. Such questions point up the fact that in some instances aerial identification without ground observation is inadequate.

In cases where the aerial field trip route is short, the flight may be preceded or followed by a surface field trip of essentially the same area. This allows students to make the comparison between the different perspectives of observation, and helps in their identification of surface features from the air. It is always a profitable experience to see a feature on the ground and then observe it from the air. In testimony of this, every student wants to fly over his own house, or over his own school or campus. From ground observation to aerial observation, it is an easy step to the identification of features of the surface of the earth on maps.

A number of class projects may follow the aerial field trip, such as written reports, examinations, aerial photograph and topographic map exercises, and or bulletin board displays. Students should be encouraged to bring their field trip photographs to class. These can be the subject of a class discussion or a bulletin board display.

In an effort to correlate the aerial field trip with map exercises, the instructor can photographically copy those portions of topographic maps which correspond to the subjects included on the colored slides made on the reconnaissance flights. These two slides, when projected side-by-side from two projectors, show the student the relationship between the actual surface features and the way they are represented on the map. Map symbols can be taught effectively in this manner, especially after the student has viewed the feature from the air.

SUMMARY

From the standpoint of terrestrial observation, and for the better teaching of geography and the conservation of natural resources in the modern world, aerial field trips should not be overlooked as an important instructional device. The flying students and instructors at schools where aerial field trips have ben conducted, testify that this method of presenting earth generalizations and interrelationships is a useful teaching technique. Many of the college students may follow such programs in their own classrooms now that the practicality and effectiveness of aerial field trips have been demonstrated.

Today, with the large number of available light airplanes, commercial pilots, and airports, aerial field trips may be made by anyone interested in the maximum observation and study of geographic phenomena.

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Figure 1
For a successful aerial field trip, the selection of the proper type of aircraft is important. It is recommended that a single-engine, four-passenger plane, with the wing above, such as the Cessna Skylark shown here, be used because of its maximum maneuverability, stability, and downward visibility.
(Photograph courtesy of the Cessna Aircraft Corporation.)

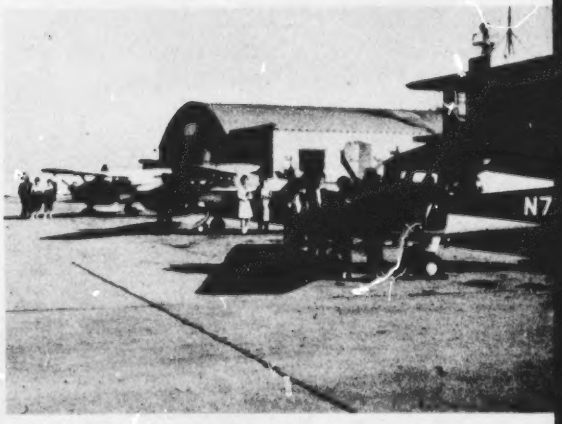


Figure 2
At Carroll College, aerial field trips have been a part of geography programs since 1958. Flights of three to four planes each have flown as many as 100 students a day.

Figure 3
Both physical and cultural features, which may be indistinct or even unobservable because of inaccessibility from the ground, force their attention on students when viewed from the high vantage platform of the airplane. Altitudes of 1,000 to 2,000 feet above the ground should be maintained for maximum identification of surface features. This photograph shows an airplane flying students from Carroll College on a geography aerial field trip. (Milwaukee Journal Photograph.)

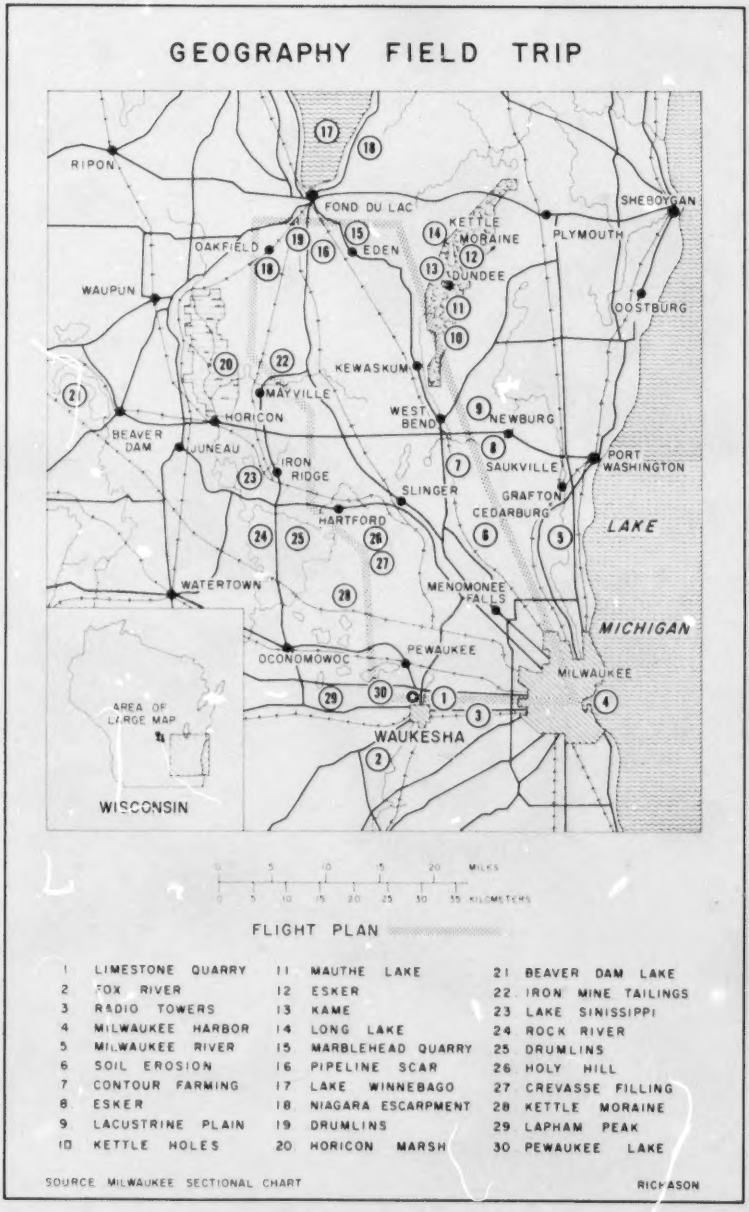


Figure 4
An example of an aerial field trip map.

Figure 5
Following a pre-flight briefing, geography students are ready to examine the earth from the air. Flight logs and field-trip maps (See Figure 4) help students identify surface features and orient themselves while in the air.

Figure 6
A tape-recorded discussion of the features observed can increase the value of aerial field trips. Shown here is the system devised at Carroll College for this purpose. The various parts include: (A) a portable, transistor tape recorder which has a listening time of about two hours on one side of the tape when ¼ mil tape is used; (B) a multiple earphone jack; and (C) ear-phones for the pilot and three students. The total cost of such equipment is under $100.

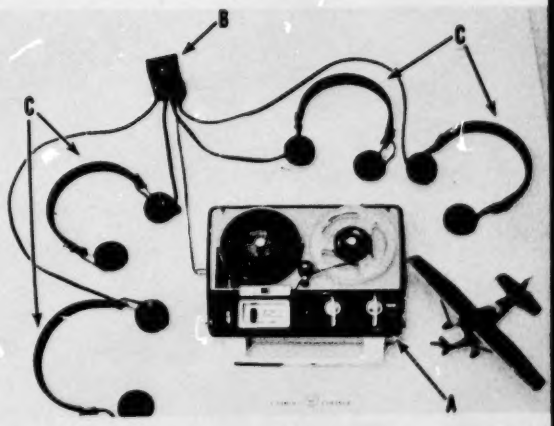


Figure 7
Carroll College geography students are seen listening to a tape-recorded discussion on an aerial field trip. (Photograph courtesy of the Carroll College News Service.)

Figure 8
Patterns of contour farming may be difficult to see from the ground, but from the air such conservation measures become impressively clear. This photograph was taken at point No. 7 on the field-trip map (See Figure 4).

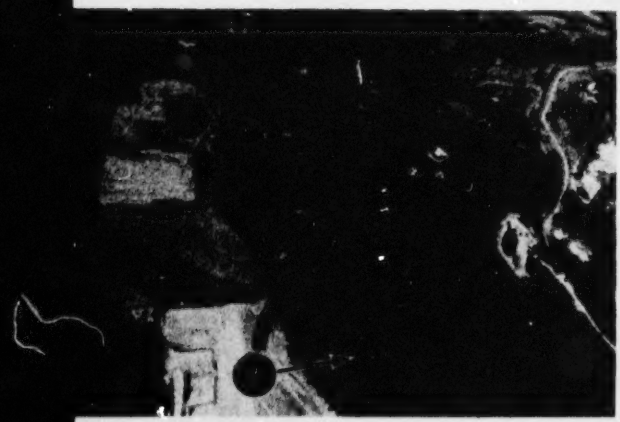
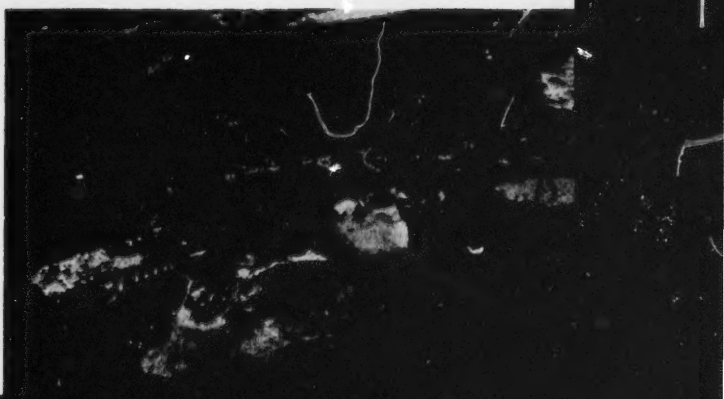


Figure 9
Because of their magnitude, many topographic features are not easily visualized by students. When seen in their reduced scale from the air, however, these features take on a new meaning for the students. Seen here is an esker (1) and a kettle lake (2). Point No. 12 on the field-trip map (See Figure 4).

Figure 10
Limestone quarry at Marblehead. No. 15 on the field-trip map.



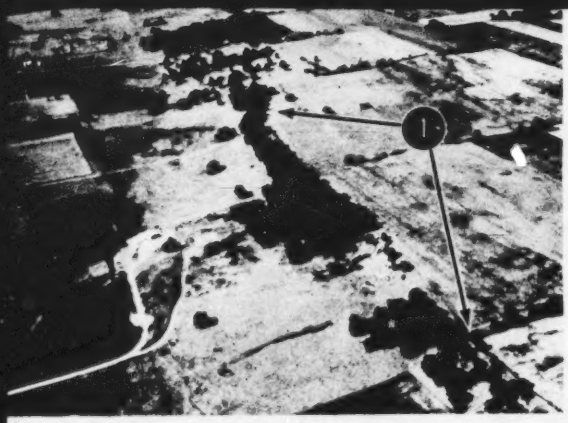


Figure 11
This section of the Niagara escarpment (1) is difficult to reach by surface field trips. From the air, however, this escarpment is easily seen. No. 18 on the field-trip map.

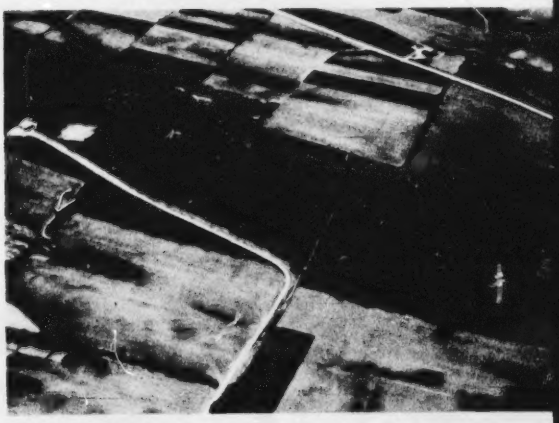


Figure 12
The long axis of the drumlin is parallel to the movement of the continental ice sheet. The tapering tail points in the direction of the ice movement. No. 19 on the field-trip map.

Figure 13
Horicon Marsh, an extensive wildlife refuge. No. 20 on the field-trip map.

Figure 14
Holy Hill. A monastary has been built on a kame deposited on the Kettle Moraine, an interlobe moraine formed between the Green Bay and Lake Michigan lobes of the Wisconsin ice sheet. No. 26 on the field-trip map.

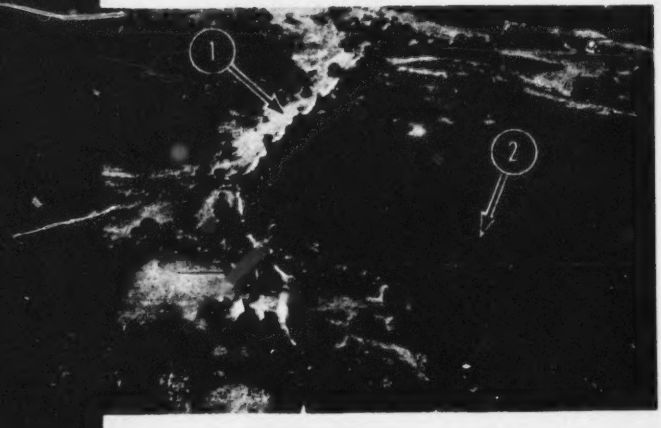
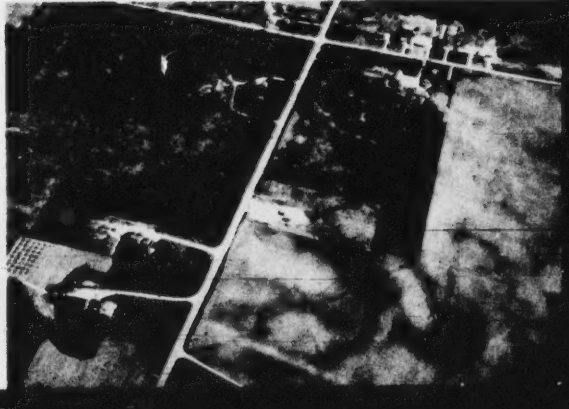


Figure 15
A crevasse filling (1) and tamarack swamp (2). No. 27 on the field-trip map.

Figure 16
Field patterns, rural settlements, and soil patterns as seen from the air.



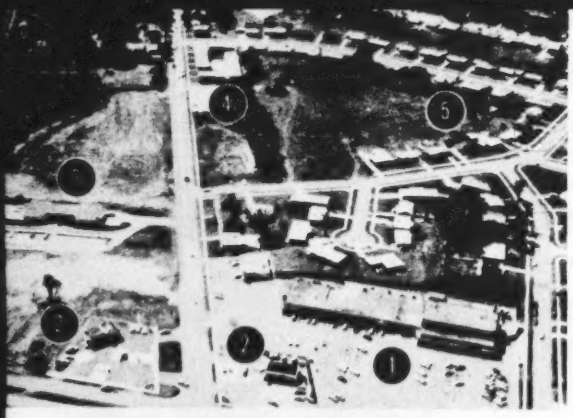


Figure 17
Suburban shopping center (1); filling stations (2); professional office building (3); apartment building (4); and a housing development (5).

Figure 18
The complexity of highway interchanges may be appreciated better from the air than on the ground.

Figure 19
A paper mill and dam on the Wisconsin River.

Figure 20
The land use of lake shores can be seen along one of the lakes in southeastern Wisconsin.

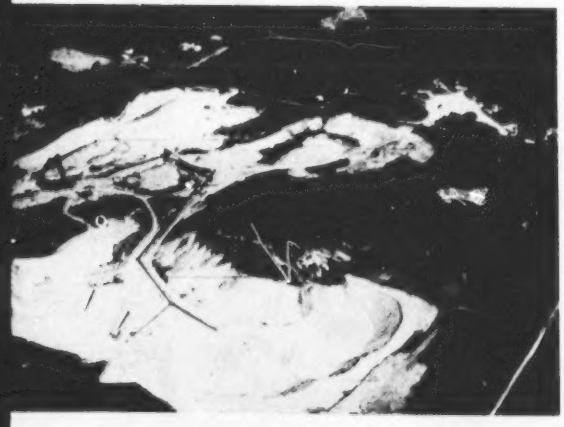


Figure 21
Sand and gravel pits are clearly discernible from the air.

Figure 22
Meanders, slip-off slopes, and point bars, the patterns of which, in many cases, cannot be seen from the ground, are distinct features when viewed from an airplane.

Figure 23
An airport in central Wisconsin.

Figure 24
The difference between old residential areas (1) and new residential subdivisions (2) is readily observable from the aerial perspective.

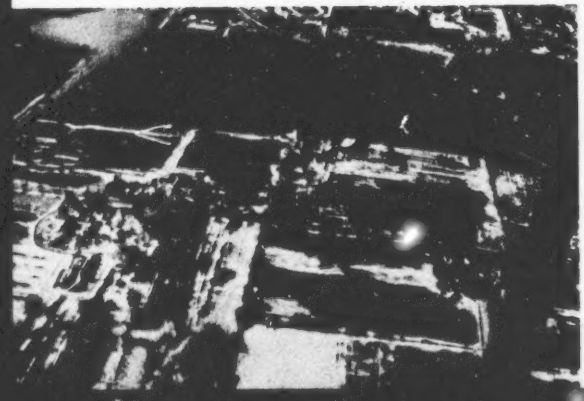


Figure 25
The winter landscape presents its own characteristics when viewed from the air. Trees without foliage permit observation of the ground. Note that the river is at flood stage following a late winter thaw. A sewage treatment plant (1) and railroad (2) may be seen. The erratic patterns on some fields (3) are where dairy farmers have spread manure.